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The Study of Gamma Ray Efficiency in Converting of Tehran Municipal Sewage Sludge into a Sanitary Fertilizer

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Abstract The reuse of urban sewage water and sludge in agriculture leads to the transfer of some pollutants into food chain and cause hazardous to public health. Sewage sludge samples are from Shahid-Mahallati wastewater treatment plant in North-East of Tehran-Iran. The heavy metals (As, Mo and Zn analysed by graphite furnace atomic absorption spectrometry (GF-AAS), Hybrid system used for Hg and flame atomic absorption used for Pb, Cd, Cu, Cr and Ni analysis), pathogens (Fecal coliforms, Salmonella, Ascaris ova) and shelf life of irradiated sludge samples according to heterotrophic mesophilic bacteria and their resistance to radiation were investigated in this paper before and after 10, 25 and 50kGy Gamma irradiation from Co60 over a period of 3 months. However, sewage sludge is a rich source of organic matter and nutrients but agricultural utilization of this material is limited by excessive quantities of heavy metals. In this paper the obtained results showed these elements were below the maximum permitted levels of EPA standard and comply with Environmental Pollution Agency standards.

The pathogens counts reduced to the extent permitted level after exposure to 10kGy. This dose had the efficiency of reducing 6 log numbers of heterotrophic mesophilic bacteria (as irradiation indicator) but exposure to 50kGy inhibited the regrowth of the bacteria for 80 days of study. Bacterial resistance (D10) was between 0.02-3.09kGy. About 0.074% of studied bacteria had D10 of 2kGy or more. The obtained result showed that 10kGy gamma rays destroyed Salmonella. The number of Fecal coliforms (dominant bacteria in human faeces) in this study were in acceptable limit before irradiation and gamma rays cause a significant reduction in their numbers (ttest, $p=0.05$). Among the helminths of sludge, Ascaris has the most resistant eggs to physical and chemical treatment, in this research the number of fertile Ascaris eggs in the sewage sludge (385/4g), were more than EPA requirements before irradiation but 10kGy gamma rays caused a reduction to acceptable limit (<1 egg/4g) so that there were no fertile eggs in irradiated studied samples. The odor of samples reduced by increasing dose in the way that 50kGy irradiated samples had no odor.

According to the obtained data, irradiation by 10kGy converted the studied sludge from class B (studied municipal sewage sludge) to class A biosolids which means that it can be applied to agricultural lands, public contact sites and home gardens. If the sludge is not used immediately after the treatment, the storage time should be regarded. Vector attraction reduction processes must be conducted before use. The capability of mentioned dose of gamma ray in converting of municipal sewage sludge into a sanitary fertilizer depends on the microbial contamination level especially the numbers of viable Ascaris eggs.

Keywords: effluent; elements; standard; irradiation; Ascaris; pathogens

Country/Organization invited to participate

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